Cedar River Gravel Study

Susan J. Perkins
Perkins Geosciences, Seattle
susanperkins@msn.com

The team of Perkins Geosciences, Jones & Stokes and Harper, Houf, & Righellis has evaluated the current conditions of spawning gravel in the Cedar River from upstream of the Landsburg diversion dam to Lake Washington. Cooperating agencies include the U.S. Army Corps of Engineers, Seattle Public Utilities, the City of Renton, and King County Department of Natural Resources. The study assessed the quality and distribution of spawning gravel with respect to the hydraulic characteristics of the river. These sediment-hydraulic relationships were then used to determine whether lack of gravel in certain reaches is caused by naturally occurring factors or human changes to channel morphology. The findings will be used to identify and implement restoration needs for the river.

Gravel supply to the Cedar River is estimated at about 11,000 to 12,000 cubic yards per year. About 4,000 to 5,000 cy/yr enters the river above Landsburg. Below Landsburg, about 6,500 cy/yr of gravel enters the river from eroding cliffs and landslides and about 800 cy/yr from tributary creeks. Most of the sediment supply below Landsburg enters the river within the first 6 miles below the diversion dam.

The diversion dam at Landsburg shows no evidence of trapping gravel. The dam gates are opened during flows that are large enough to transport gravel, allowing bedload sediment to move through. The high gradient and shear stresses below Landsburg preclude gravel deposition, even though the sediment supply doubles from cliff erosion in the first 4 miles downstream. Low amounts of available spawning area persist for nearly 8 river miles downstream of Landsburg. These gravel-poor segments have gradients above 0.45% and shear stresses above 1.7 lbs/ft^2 in the 5-year flood.

In contrast, the gravel-rich channel above the Landsburg pool has a gradient of 0.3% and shear stress of 0.9 lbs/ft^2. Shear stress that low is not found in any other river segments except the Renton channel.

Gravel supply to the river was higher in the early twentieth century. Gravel supply above Landsburg is likely to drop slightly within the next 15 years due to the cessation of timber harvest in the watershed. This represents a return to lower sediment supply that existed prior to human disturbance of the watershed.

Extremes of gravel presence or absence in the Cedar River are related to geomorphology and hydraulics. River segments with high gradients, high shear stresses, and high gradient-confinement indices had low available spawning area (less than 11%) indicating that high value of these parameters are limiting. Segments with over 30% available spawning area had low values of these parameters. In between these extremes, segments had a wide range of available spawning area that was not explained by any of the morphologic or hydrologic variables.

Substrate in the medium-gravel-to-fine-cobble size range suitable for spawning was found in all the surveyed river segments, although the area of suitable substrate was small in the steeper segments below Landsburg Dam.

Above River Mile 1, subsurface gravel samples collected within the river channel all had cumulative percentages of sediment finer than 0.85 mm well within the NMFS criteria of a properly functioning system. Half the samples below River Mile 1 had fine sediment levels in excess of the 12 percent criterion.

Below Landsburg, the highest proportion of available spawning area occurs in the only two river segments with active gravel deposition, perennial side channels and frequent floodplain inundation. These conditions are absent along most of the river due to flood control, confinement by levees, roads, bridges and cliffs, and steep gradients in some segments.

Although the largest amounts of available spawning area occur in depositional zones, Cedar River chinook salmon and steelhead primarily utilize somewhat steeper channels that do not have depositional morphology. Sockeye salmon utilize the Renton channel heavily despite the fine sediment. No recent data are available for sockeye utilization in the rest of the river.

The area of gravel in the size range suitable for spawning could be increased by setting back levees that confine the channel and excavating high banks to reestablish floodplain function. The resulting drop in shear stress would promote gravel deposition and reduce sediment size. Where channel migration can be restored, the resulting channels would have a diversity of substrate sizes and velocities.

To increase spawning gravel that could be used by all species of salmonids, restoration efforts should focus on segments with moderate gradients in the middle portion of the study area. Excellent opportunities exist in Segments 11, 12 and 16 where levees protect large tracts of undeveloped floodplain. Spawning gravel improvements in the lower river would likely be utilized by sockeye but not other species.